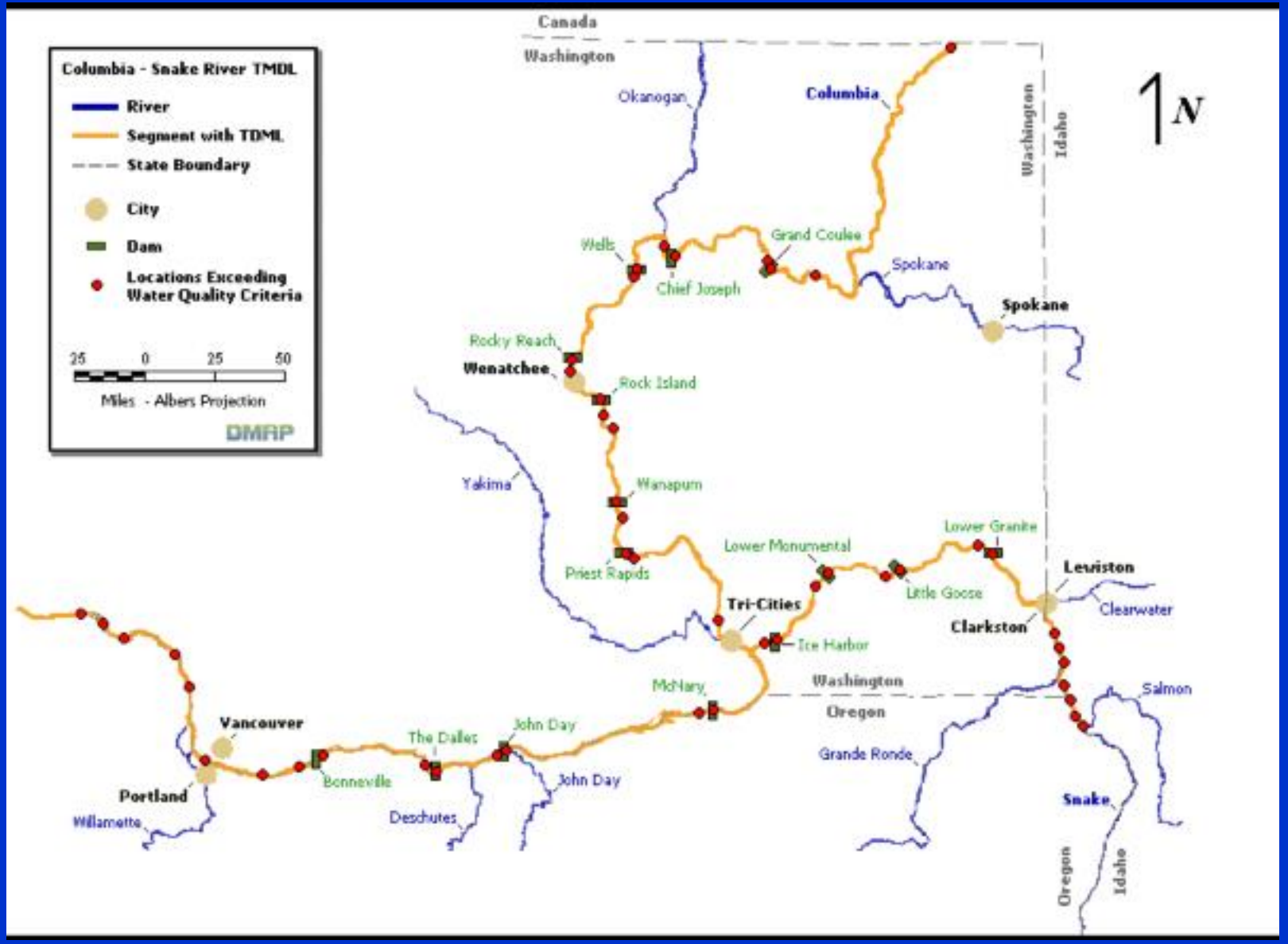
Columbia/Snake River Temperature TMDL

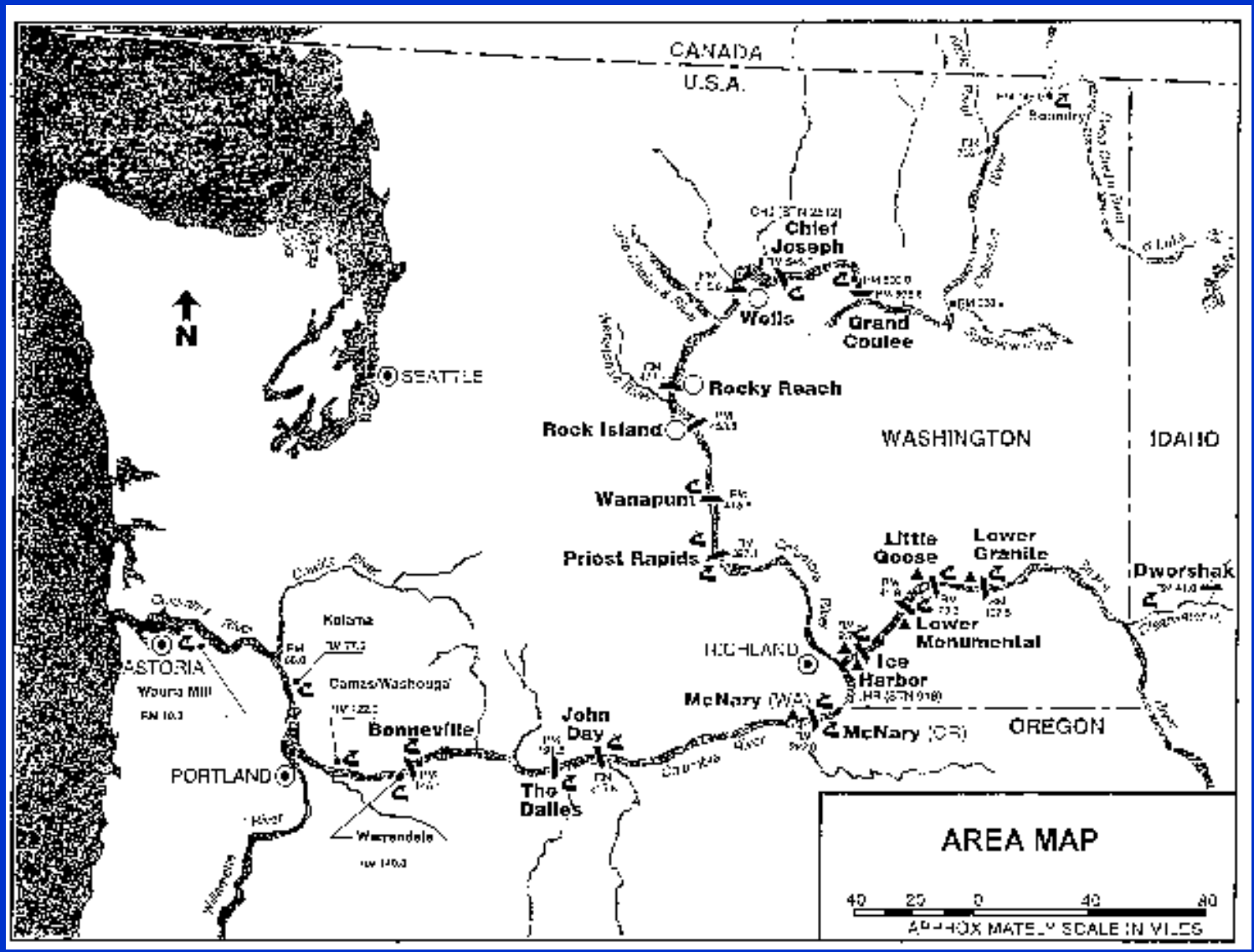
What is a TMDL?

- The amount of a pollutant that a water body can receive and still meet water quality standards.
- The sum of allowable loads from point and non-point sources, considering seasonal variation and a margin of safety.
- It determines the sources of pollutants causing or contributing to impairment.
- It allocates responsibility for reductions needed to achieve water quality standards.

Geographic Scope



Geographic Scope



Temperature TMDL Technical Process

- Define the numerical targets for the TMDL.
- Characterize existing conditions.
- Identify sources and evaluate linkages between sources and temperature response of the river.
- Quantify loading capacity.
- Allocate loads.

Defining the Numerical Targets

- **The WQS establish the numerical targets for the TMDL.**
- **The WQS for most of the river prohibit or restrict temperature increases due to human activities.**
- **So we have to estimate temperature in the absence of human activity that affects temperature (natural or site potential).**

Canadian Border

Temperature shall not exceed 16 Degrees C due to human activities.

WA and Colville WQS

Grand Coulee Dam

Chief Joseph

Wells

Temperature shall not exceed 18 Degrees C due to human activities.

WA and ColvilleWQS

Priest Rapids Dam

Temperature shall not exceed 20 Degrees C due to human activities.

WA WQS

OR/WA Border

Temperature shall not exceed 20 Degrees C due to human activities.

WA WQS

No measurable surface water temperature increase resulting from anthropogenic activities is allowed when temperatures exceed 20 degrees centigrade (7 day running average of the daily maximums)

OR WQS

Pacific Ocean

Salmon River

22 Degrees C Maximum
19 Degrees C Daily Average

ID WQS

No measurable surface water temperature increase resulting from anthropogenic activities is allowed when temperatures exceed 17.8 degrees centigrade from July 1 to Sept 30 and 12.8 Degrees C from Oct 1 to June 30.

OR WQS

OR/WA/ID Border

22 Degrees C Maximum
19 Degrees C Daily Average

ID WQS

Temperature shall not exceed 20 Degrees C due to human activities.

WA WQS

WA/ID Border

Temperature shall not exceed 20 Degrees C due to human Activities.

WA WQS

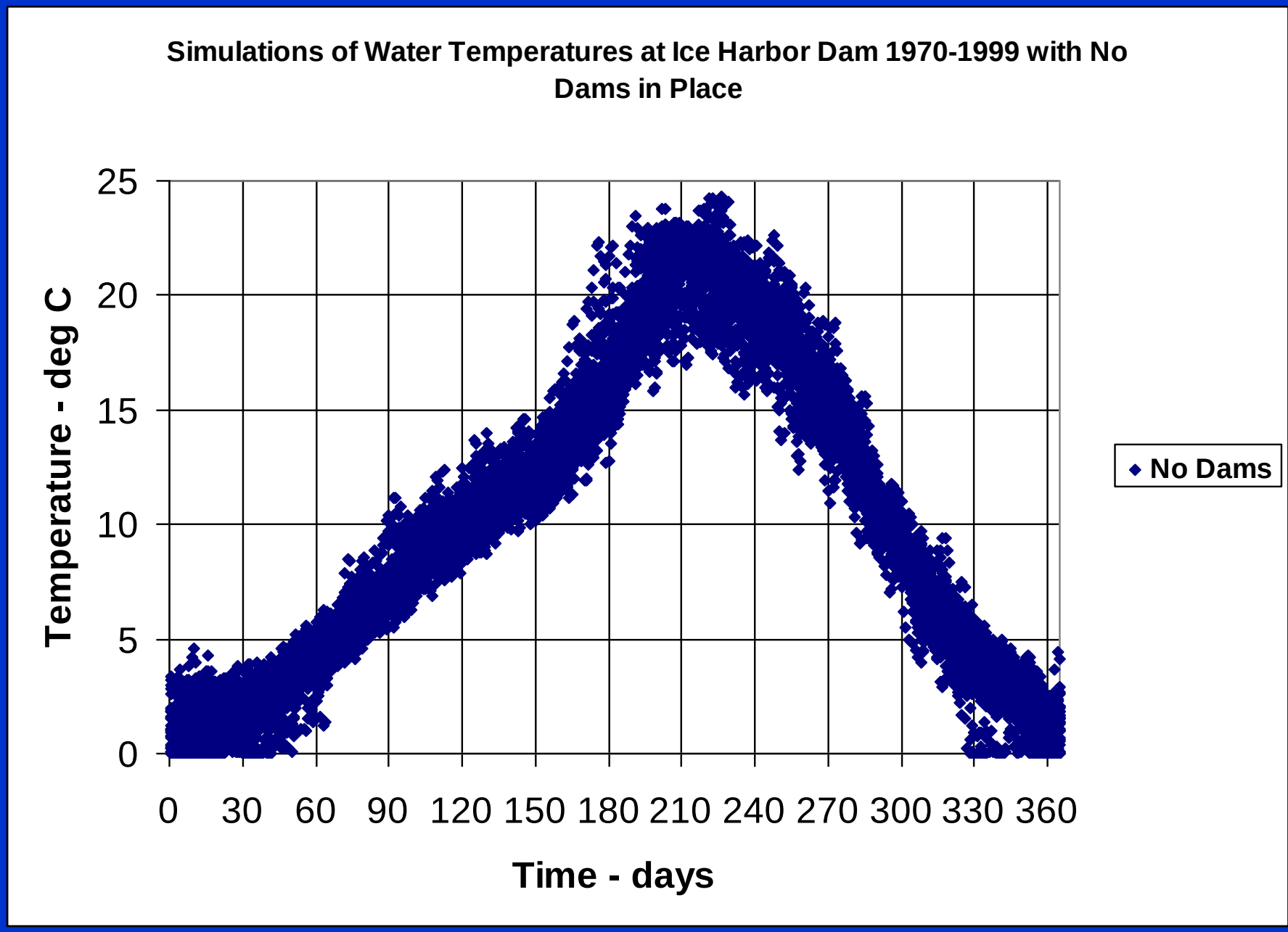
Columbia River

Defining Numerical Targets

- When natural conditions exceed the criteria in the WQS, the natural or site potential temperatures will be used to establish the numerical targets for the TMDL.

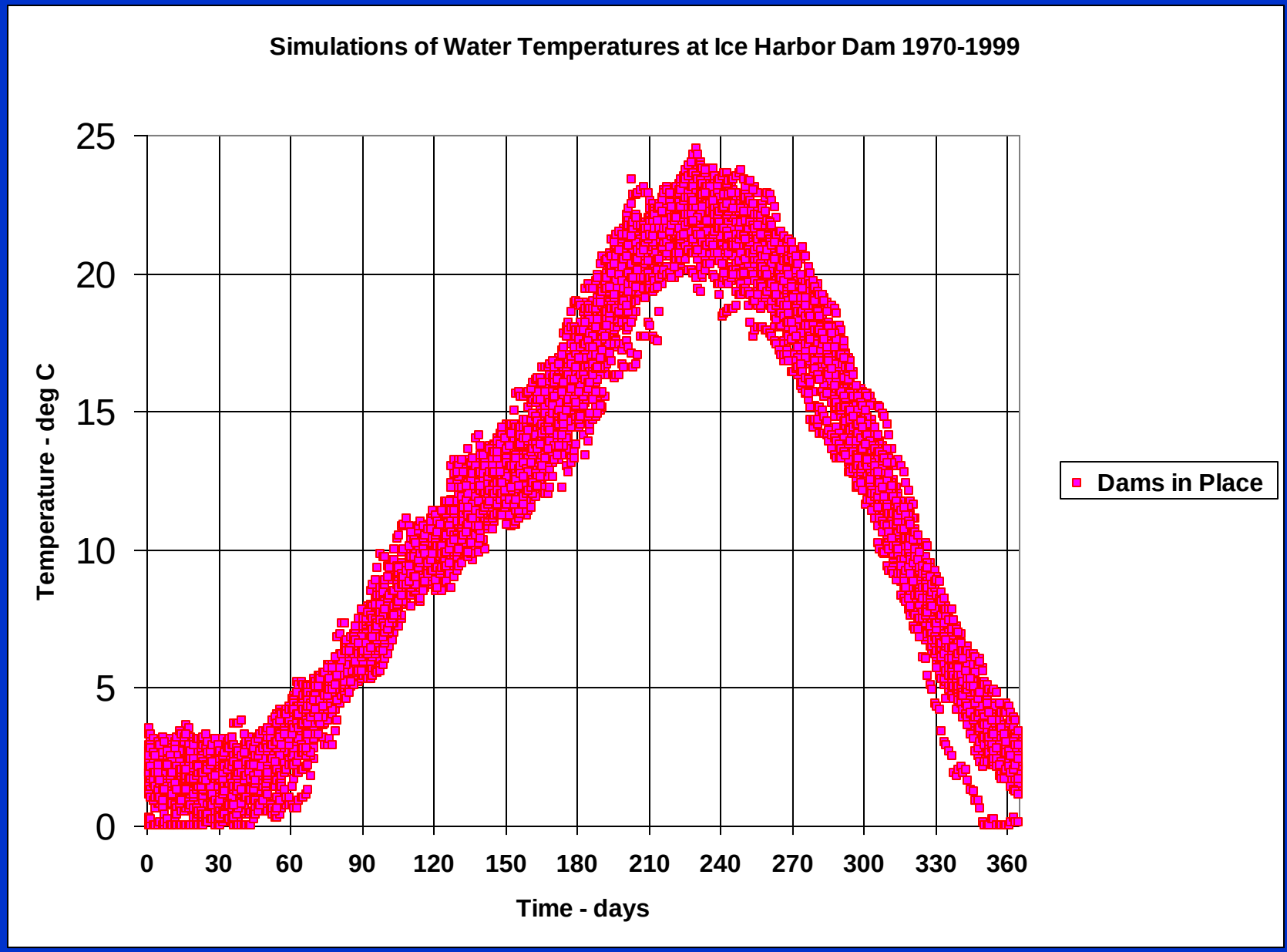
Defining Numerical Targets

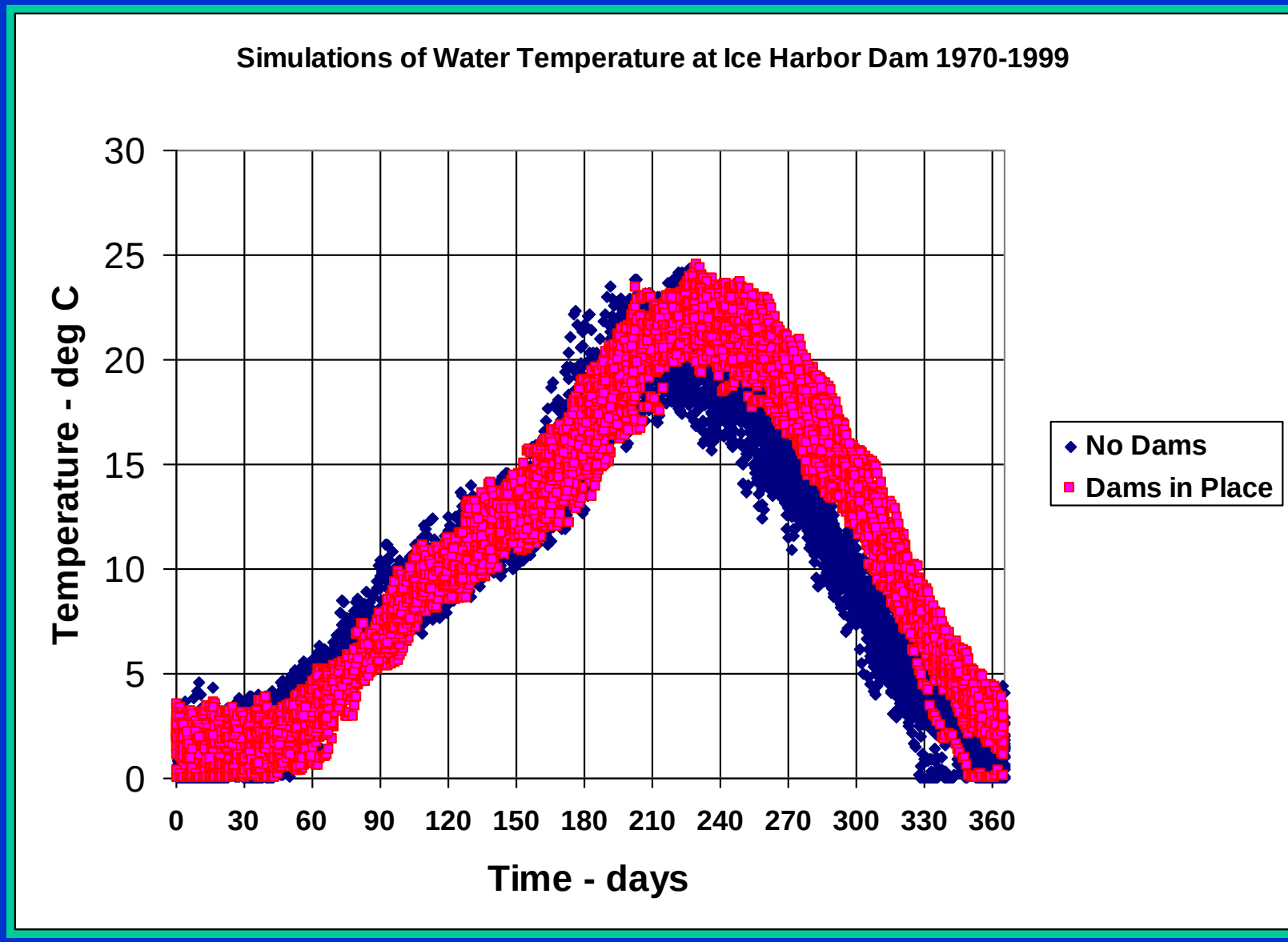
- **Use RBM 10 Water Quality Model to simulate the average temperature of cross sections of the river.**
- **Simulate 30 years of water temperature using existing meteorological and hydrological data.**


Simulations of Water Temperatures at Ice Harbor Dam 1970-1999 with No Dams in Place
Temperature - deg C
25
20
15
10
5
0
0
30
60
90
120
150
180
210
240
270
300
330
360
Time - days
No Dams

Characterization of Existing Conditions

- **Use the RBM-10 Model to simulate existing conditions.**
  - **Compare apples to apples**
  - **Fill in data gaps**


Simulations of Water Temperatures at Ice Harbor Dam 1970-1999
Temperature - deg C
0
5
10
15
20
25
0
30
60
90
120
150
180
210
240
270
300
330
360
Time - days
Dams in Place


Simulations of Water Temperature at Ice Harbor Dam 1970-1999
Temperature - deg C
30
25
20
15
10
5
0
0
30
60
90
120
150
180
210
240
270
300
330
360
Time - days
No Dams
Dams in Place

Identify and Evaluate Heat Sources or other Causes of Increased Temperature

- Point Sources
- Dams
- Tributaries
- Irrigation Return Flows

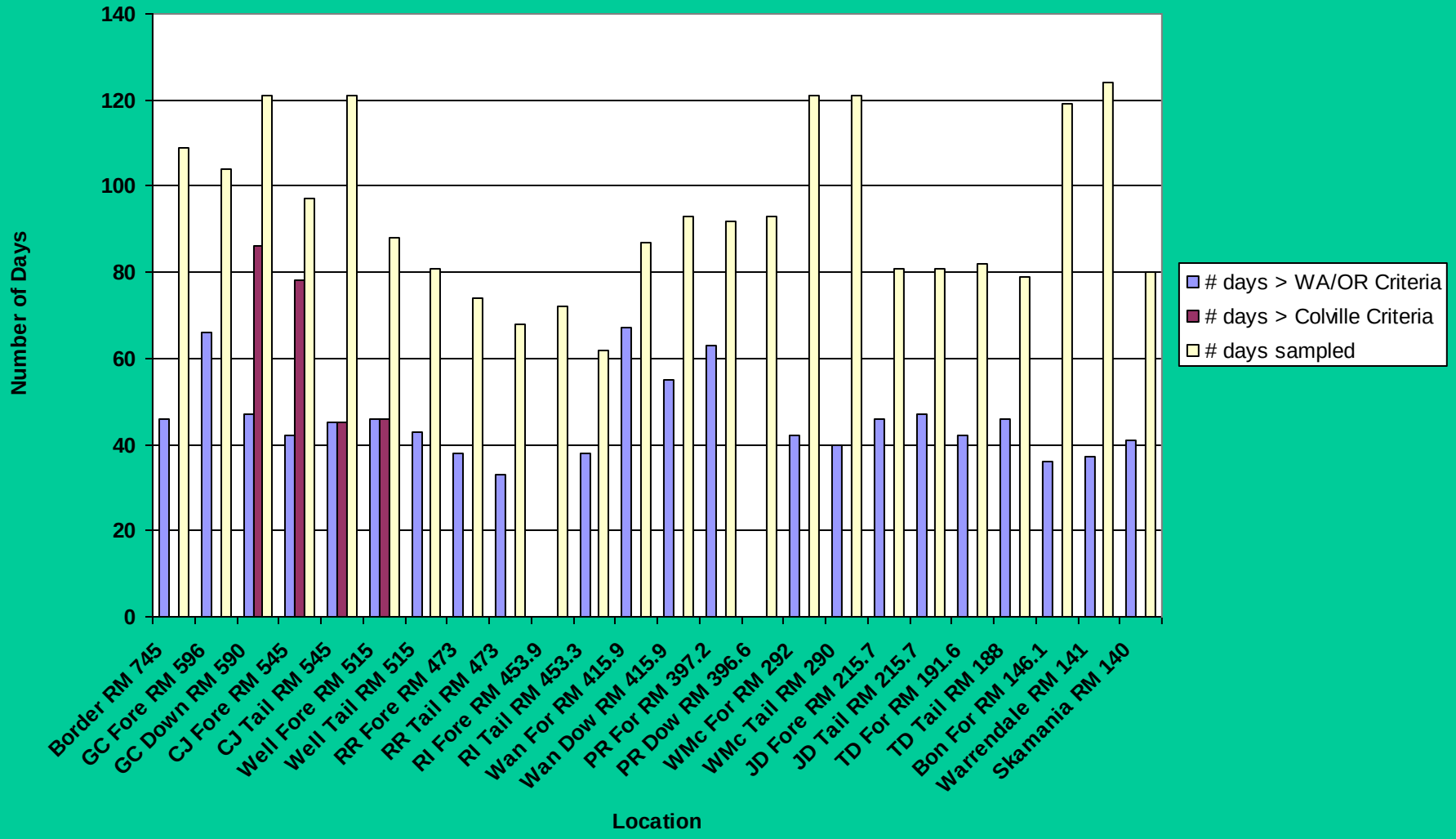
Quantify Loading Capacity

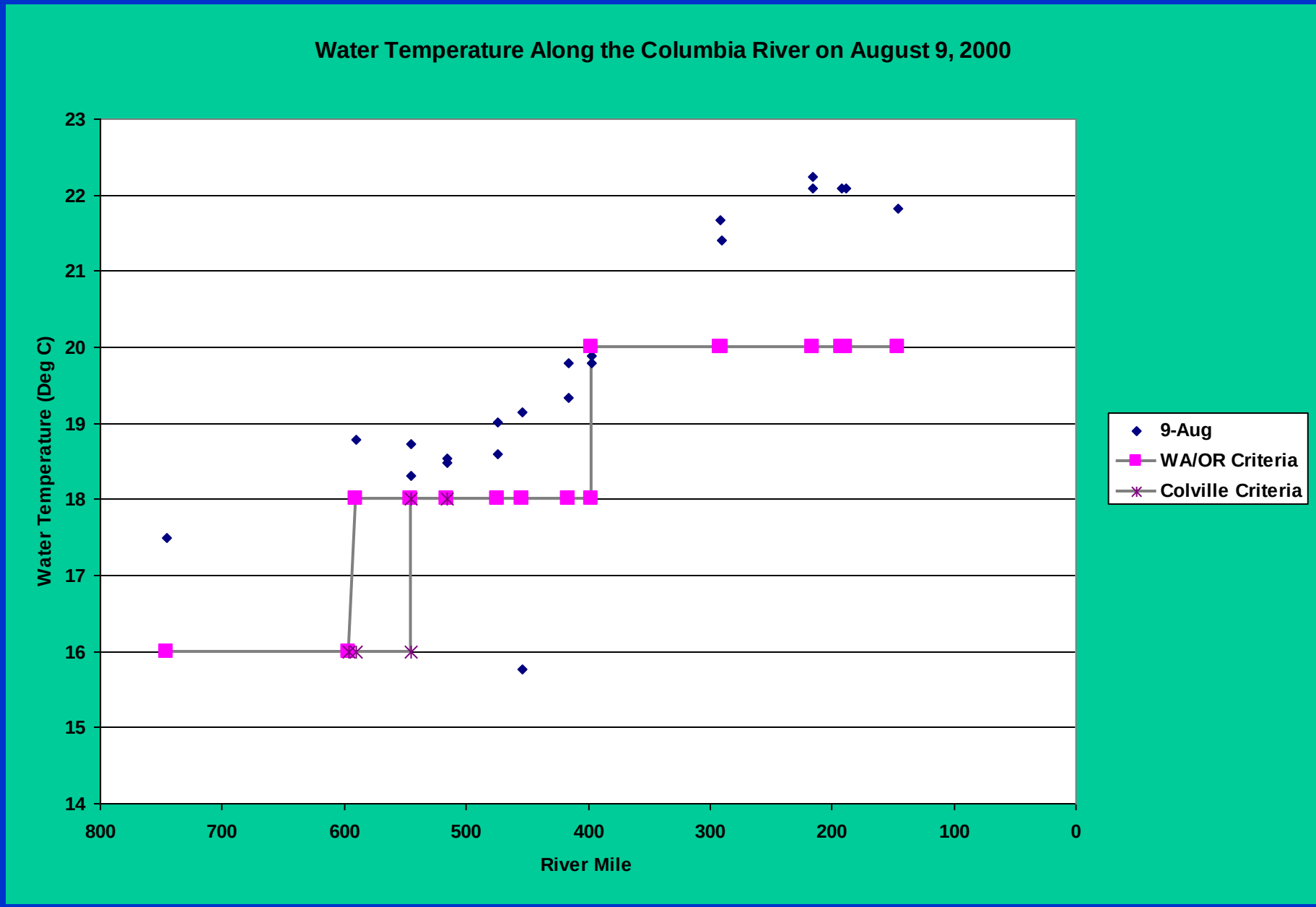
- **Use the loads from the RBM10 simulations of natural or site potential conditions.**

Allocate Loads

- **Use RBM10 for “far field” Waste Load Allocations**
- **Further adjust loads if necessary to achieve WQS at the edge of the mixing zone.**

July Through October, 2000 - Number of Days during which Water Temperature along the Columbia River Exceeded Water Quality Criteria




Water Temperature Along the Columbia River on August 9, 2000
Water Temperature (Deg C)
23
22
21
20
19
18
17
16
15
14
800
700
600
500
400
300
200
100
0
River Mile
9-Aug
WA/OR Criteria
Colville Criteria

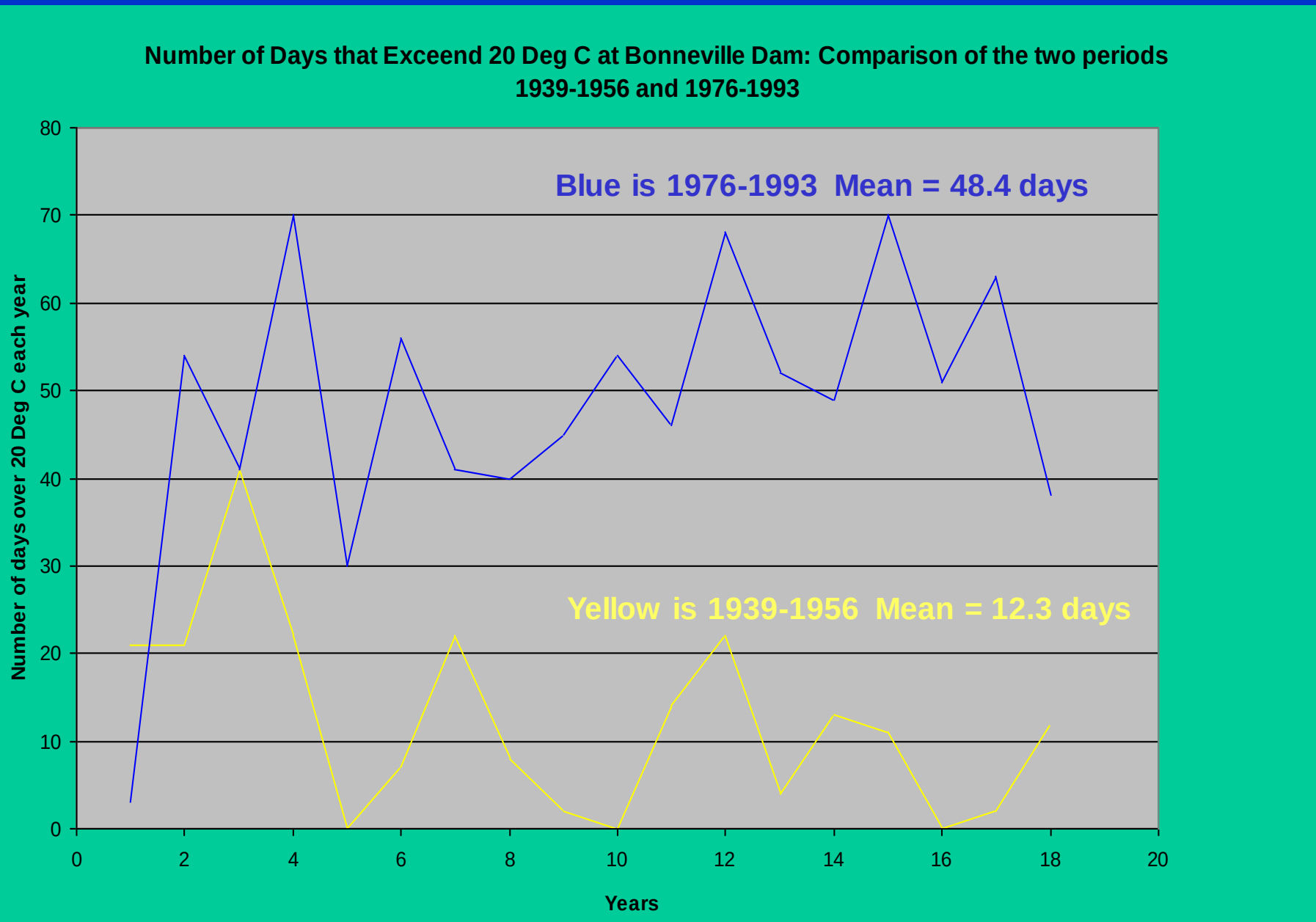
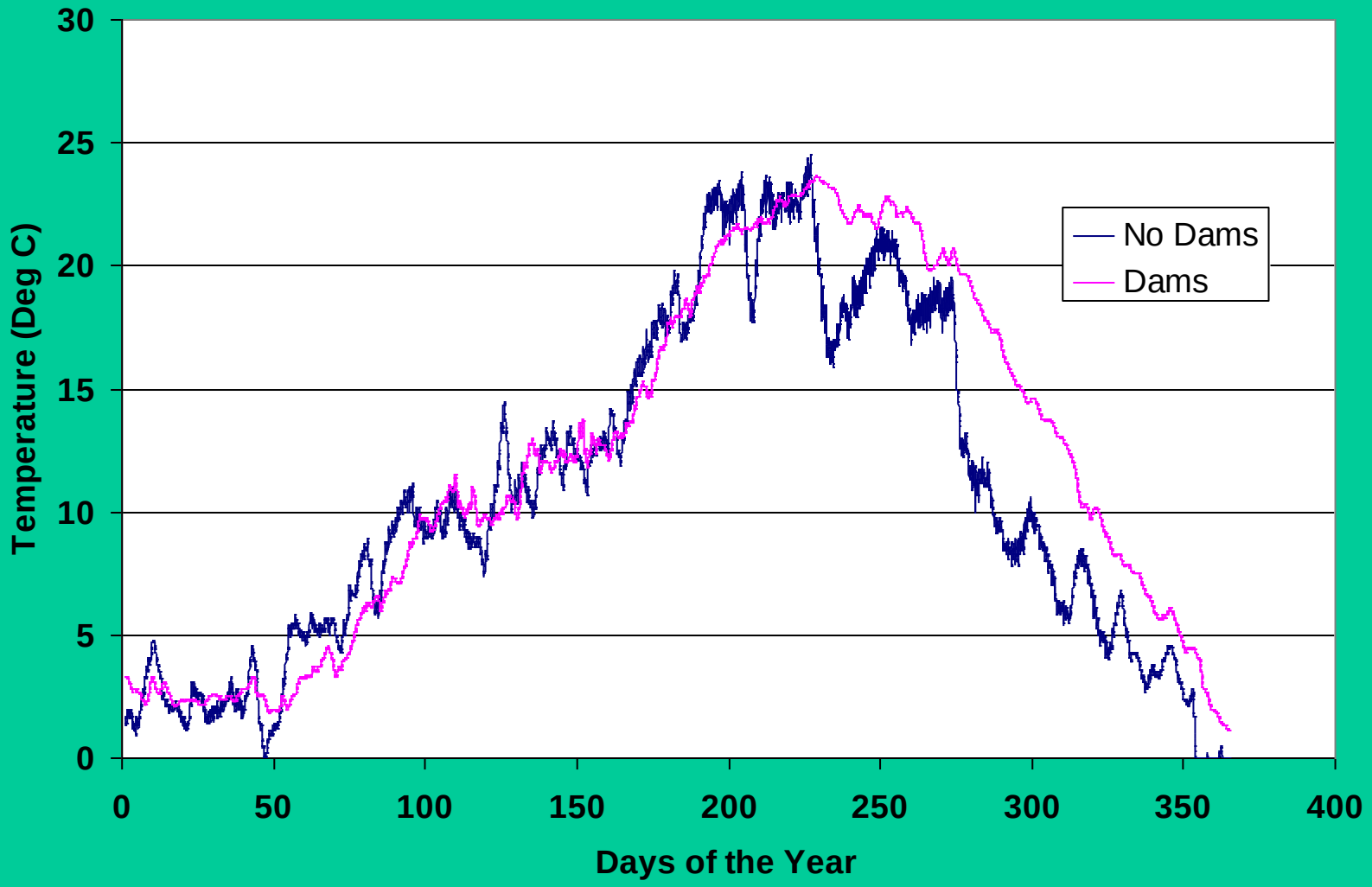
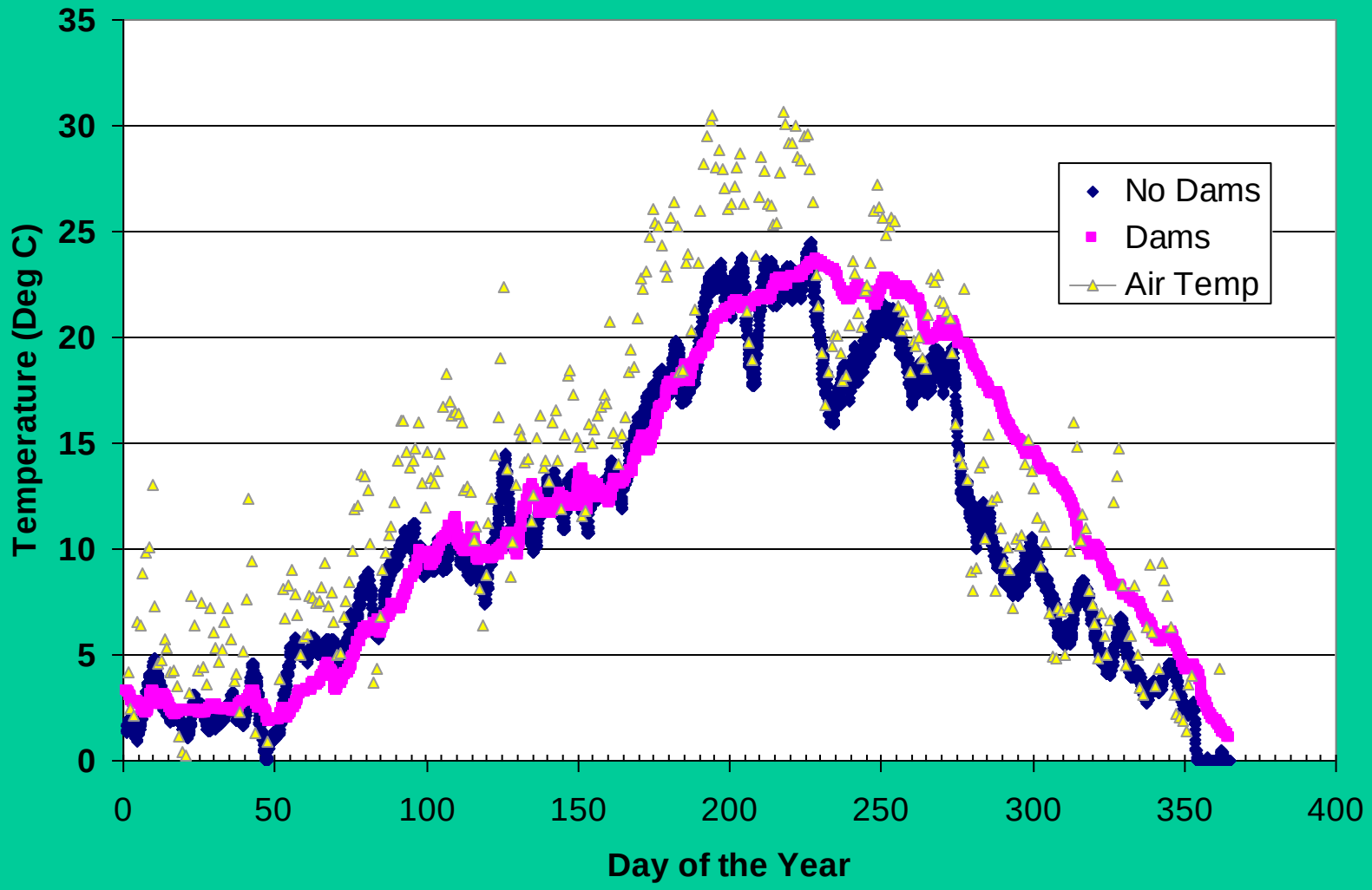

Number of Days that Exceend 20 Deg C at Bonneville Dam: Comparison of the two periods 1939-1956 and 1976-1993
Blue is 1976-1993 Mean = 48.4 days
Yellow is 1939-1956 Mean = 12.3 days
Number of days over 20 Deg C each year
Years
0
10
20
30
40
50
60
70
80
0
2
4
6
8
10
12
14
16
18
20

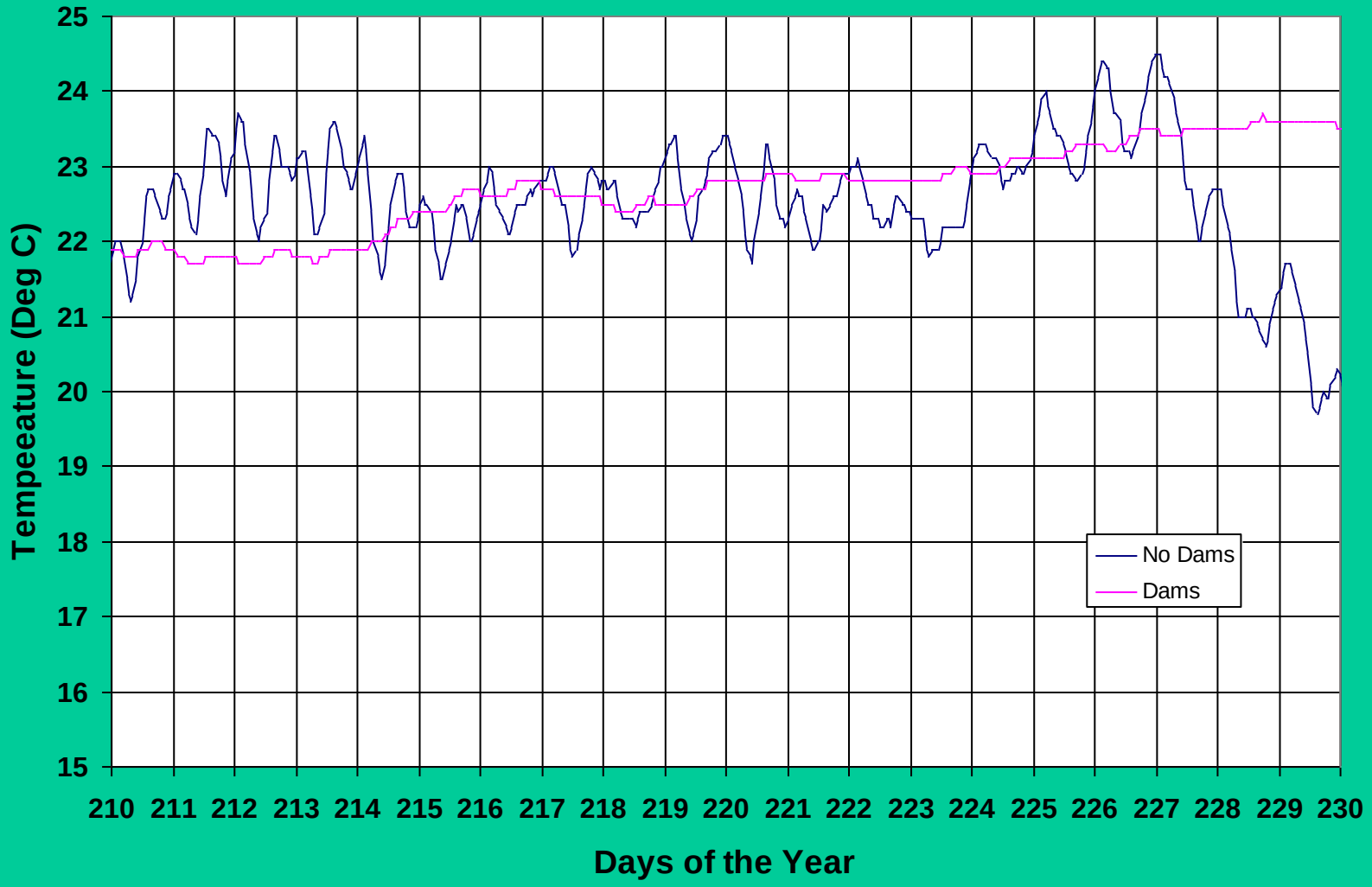
Figure 3-12. Simulated Water Temperature at Ice harbor Dam 1990 - Dams in Place and Dams Removed



Simulations of Water Temperature at Ice Harbor Dam 1990 with Dams in Place and Dams Removed Compared to Air Temperature at Lewiston, ID



Simulated Water Temperature at Ice Harbor Dam 1990 - Dams in Place and Dams Removed



How has the Temperature Regime of the River Changed?

- Longer periods with temperatures in the warm range for coldwater biota;
- Temperature gradients in the reservoirs resulting in warm surface water;
- Less fluctuation in temperature - daily and in response to meteorology.
- Loss of cold water refugia due to flooding of the alluvial flood plains.

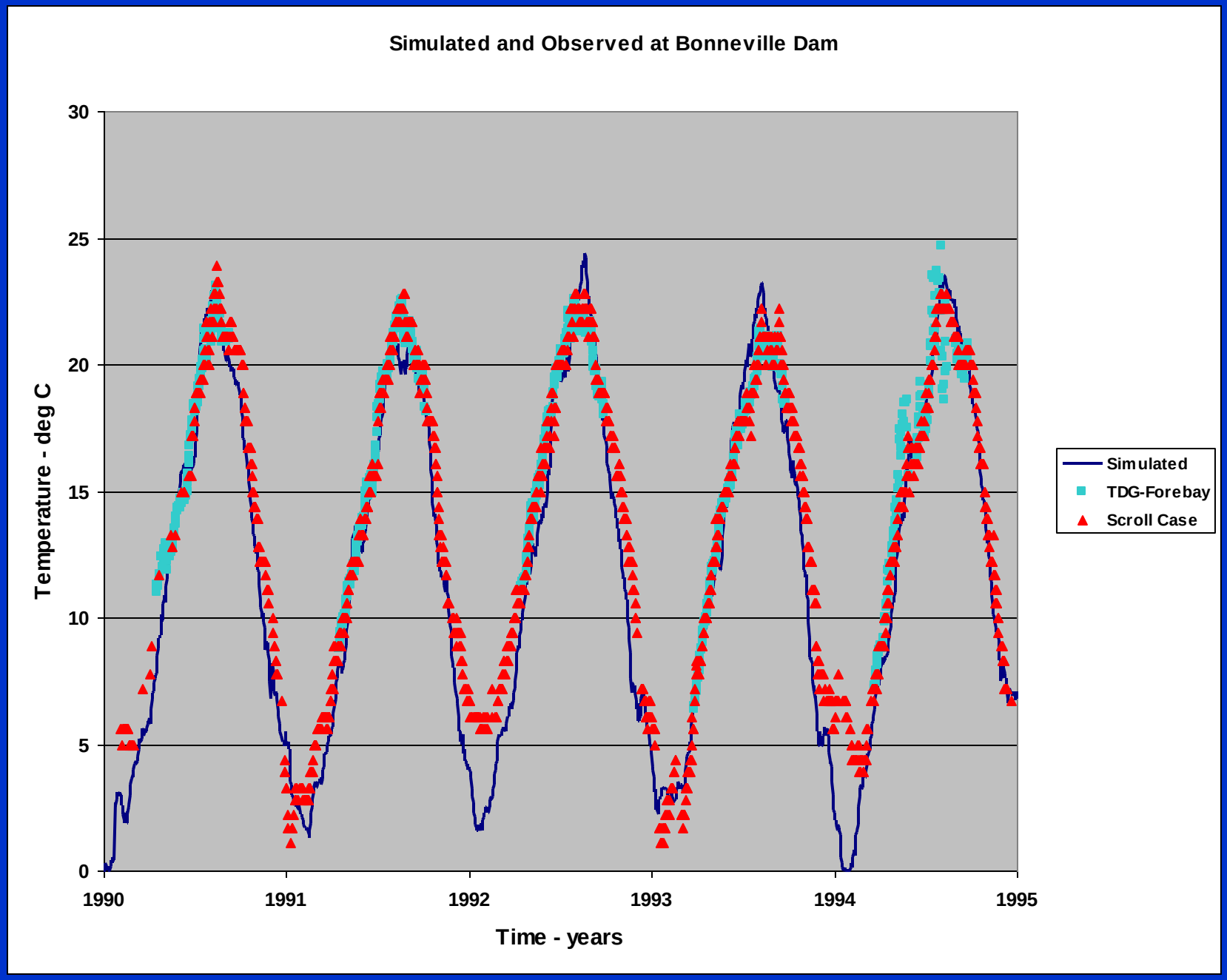
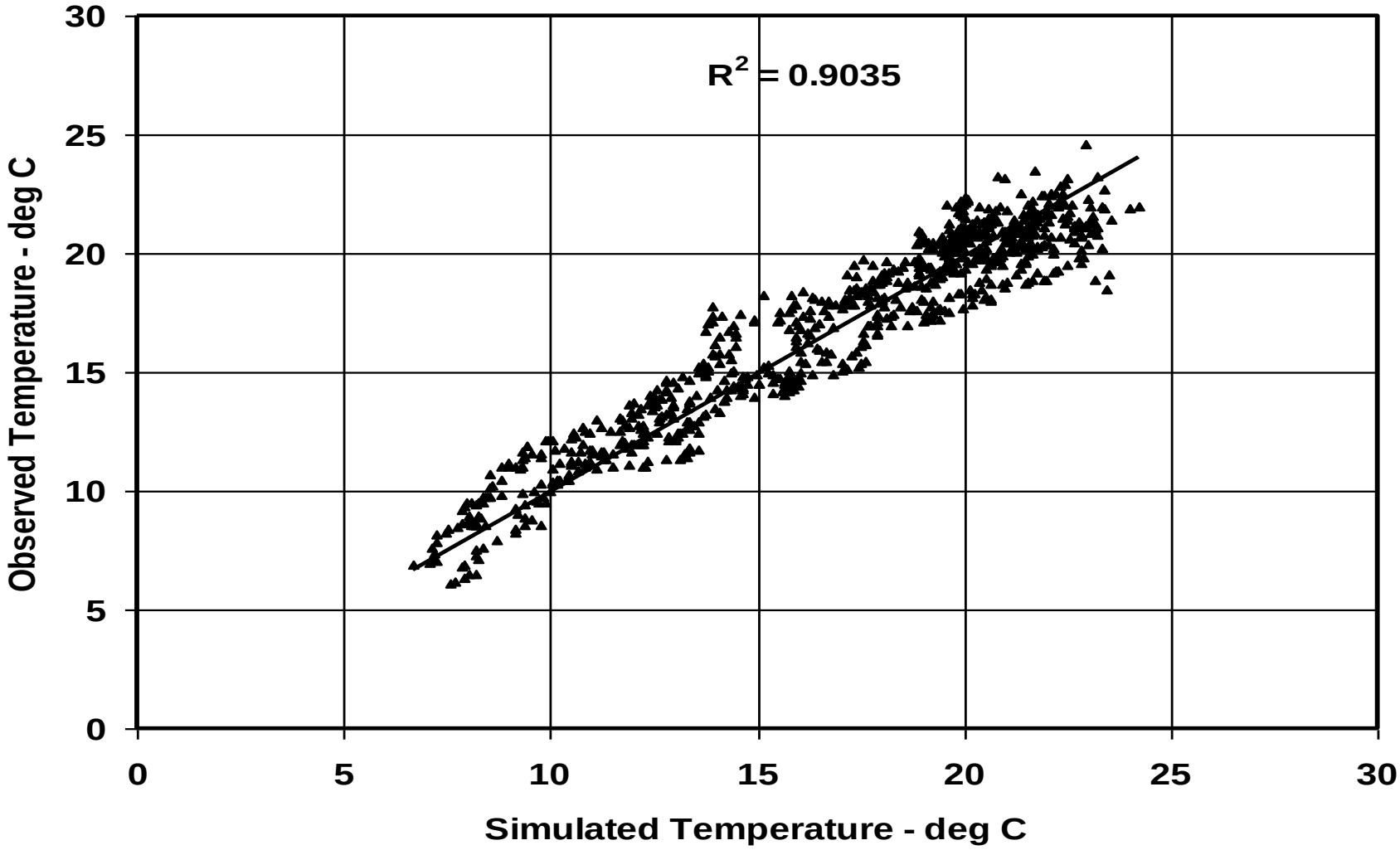

Simulated and Observed at Bonneville Dam
Temperature - deg C
30
25
20
15
10
5
0
1990
1991
1992
1993
1994
1995
Time - years
Simulated
TDG-Forebay
Scroll Case

Figure D-5. Regression of observed on simulated at Bonneville Dam 1990-1995.



RBM10 Results for 1990-1994

Location	*Mean Difference (Obs-Sim)*	*Standard Deviation*
Snake River @Ice Harbor	0.05 deg C	1.2
Columbia River @Bonneville	0.04 deg C	1.3

Error Estimates from Other Studies

- **RISLEY (1997) - Tualatin River**
  Max Mean Difference = 3 Deg C
  Mostly < 1 Deg C

- **BATTELLE-MASS1 (2001) - Columbia River**
  RMS Error = 0.59 - 1.52 Deg C

- **HDR/PORTLAND STATE/IPC (1999) - Snake River**
  AME = 0.6-2.3 Deg C (1992 data)
  AME = 0.5-2.0 Deg C (1995 data)

- **CHEN (1996) - Grande Ronde River**
  Error = -2.20 - 8.28 Deg C (Summer Max)
  Error = -1.21 - 7.69 Deg C (Avg 7-day Max)